4. (a) $[-\sqrt{2}, \sqrt{2}]$
(b) $[-2, -\sqrt{2}]$ and $[\sqrt{2}, 2]$
(c) $(-2, 0)$
(d) $(0, 2)$
(e) Local max: $(-2, 0)$ and $(\sqrt{2}, 2)$; local min: $(2, 0)$ and $(-\sqrt{2}, -2)$

5. (a) Approximately $(-\infty, 0.385]$
(b) Approximately $[0.385, \infty)$
(c) None (d) $(-\infty, \infty)$
(e) Local maximum at $\approx (0.385, 1.215)$
(f) None

6. (a) $[1, \infty)$ (b) $(-\infty, 1]$
(c) $(-\infty, \infty)$ (d) None
(e) Local minimum at $(1, 0)$
(f) None

7. (a) $[0, 1)$ (b) $(-1, 0]$
(c) $(-1, 1)$ (d) None
(e) Local minimum at $(0, 1)$
(f) None

8. (a) $(-\infty, -2^{-1/3}] \approx (-\infty, -0.794]$
(b) $[-2^{-1/3}, 1) \approx [-0.794, 1)$ and $(1, \infty)$
(c) $(-\infty, -2^{1/3}) \approx (-\infty, -1.260)$ and $(1, \infty)$
(d) $(-1.260, 1)$
(e) Local maximum at

$$\left(-2^{-1/3}, \frac{2}{3}\cdot 2^{-1/3}\right) \approx (-0.794, 0.529)$$

(f) $\left(-2^{1/3}, \frac{1}{3}\cdot 2^{1/3}\right) \approx (-1.260, 0.420)$

9. (a) None
(b) $[-1, 1]$
(c) $(-1, 0)$
(d) $(0, 1)$
(e) Local maximum at $(-1, \pi)$; local minimum at $(1, 0)$
(f) $\left(0, \frac{\pi}{2}\right)$

10. (a) $[-\sqrt{3}, \sqrt{3}]$
(b) $(-\infty, -\sqrt{3}]$ and $[\sqrt{3}, \infty)$
(c) Approximately $(-2.584, -0.706)$ and $(3.290, \infty)$
(d) Approximately $(-\infty, -2.584)$ and $(-0.706, 3.290)$
(e) Local maximum at

$$\left(\sqrt{3}, \frac{\sqrt{3}-1}{4}\right) \approx (1.732, 0.183);$$

local minimum at

$$\left(-\sqrt{3}, \frac{-\sqrt{3}-1}{4}\right) \approx (-1.732, -0.683)$$

(f) $\approx (-2.584, -0.573)$, $(-0.706, -0.338)$, and $(3.290, 0.161)$

11. (a) $(0, 2]$ (b) $[-2, 0)$
(c) None (d) $(-2, 0)$ and $(0, 2)$
(e) Local maxima at $(-2, \ln 2)$ and $(2, \ln 2)$
(f) None

12. (a) Approximately $[0, 0.176]$, $\left[0.994, \frac{\pi}{2}\right]$, $[2.148, 2.965]$, $\left[3.834, \frac{3\pi}{2}\right]$, and $[5.591, 2\pi]$
(b) Approximately $[0.176, 0.994]$, $\left[\frac{\pi}{2}, 2.148\right]$, $[2.965, 3.834]$, and $\left[\frac{3\pi}{2}, 5.591\right]$
(c) Approximately $(0.542, 1.266)$, $(1.876, 2.600)$, $(3.425, 4.281)$, and $(5.144, 6.000)$
(d) Approximately $(0, 0.542)$, $(1.266, 1.876)$, $(2.600, 3.425)$, $(4.281, 5.144)$, and $(6.000, 2\pi)$
(e) Local maxima at $\approx (0.176, 1.266)$, $\left(\frac{\pi}{2}, 0\right)$ and $(2.965, 1.266)$, $\left(\frac{3\pi}{2}, 2\right)$, and $(2\pi, 1)$;
local minima at $\approx (0, 1)$, $(0.994, -0.513)$, $(2.148, -0.513)$, $(3.834, -1.806)$, and $(5.591, -1.806)$
Note that the local extrema at $x \approx 3.834$, $x = \frac{3\pi}{2}$, and $x \approx 5.591$ are also absolute extrema.
(f) $\approx (0.542, 0.437)$, $(1.266, -0.267)$, $(1.876, -0.267)$, $(2.600, 0.437)$, $(3.425, -0.329)$, $(4.281, 0.120)$, $(5.144, 0.120)$, and $(6.000, -0.329)$

13. (a) $\left(0, \frac{2}{\sqrt{3}}\right]$
(b) $(-\infty, 0]$ and $\left[\frac{2}{\sqrt{3}}, \infty\right)$
(c) $(-\infty, 0)$
(d) $(0, \infty)$
(e) Local maximum at

$$\left(\frac{2}{\sqrt{3}}, \frac{16}{3\sqrt{3}}\right) \approx (1.155, 3.079)$$

(f) None

14. (a) Approximately $[-0.578, 1.692]$
(b) Approximately $(-\infty, -0.578]$ and $[1.692, \infty)$
(c) Approximately $(-\infty, 1.079)$
(d) Approximately $(1.079, \infty)$
(e) Local maximum at $\approx (1.692, 20.517)$; local minimum at $\approx (-0.578, 0.972)$
(f) $\approx (1.079, 13.601)$

15. (a) $\left[0, \frac{8}{9}\right]$ (b) $(-\infty, 0]$ and $\left[\frac{8}{9}, \infty\right)$
(c) $\left(-\infty, -\frac{2}{9}\right)$ (d) $\left(-\frac{2}{9}, 0\right)$ and $(0, \infty)$
(e) Local maximum at $\approx (0.889, 1.011)$; local minimum at $(0, 0)$
(f) $\approx \left(-\frac{2}{9}, 0.667\right)$

16. (a) Approximately $(-\infty, 0.215]$
(b) Approximately $[0.215, 2)$ and $(2, \infty)$
(c) Approximately $(2, 3.710)$
(d) $(-\infty, 2)$ and approximately $(3.710, \infty)$
(e) Local maximum at $\approx (0.215, -2.417)$
(f) $\approx (3.710, -3.420)$

17. (a) None (b) At $x = -1$ (c) At $x = 0$ and $x = 2$

18. (a) At $x = -1$ (b) At $x = 2$ (c) At $x = \frac{1}{2}$

19. $f(x) = -\frac{1}{4}x^{-4} - e^{-x} + C$

20. $f(x) = \sec x + C$

21. $f(x) = 2\ln x + \frac{1}{3}x^3 + x + C$

22. $f(x) = \frac{2}{3}x^{3/2} + 2x^{1/2} + C$

23. $f(x) = -\cos x + \sin x + 2$

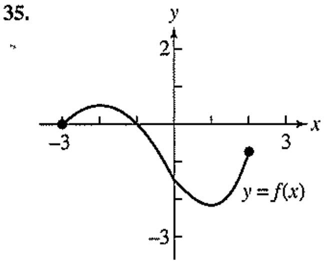
24. $f(x) = \frac{3}{4}x^{4/3} + \frac{x^3}{3} + \frac{x^2}{2} + x - \frac{31}{12}$

25. $s(t) = 4.9t^2 + 5t + 10$

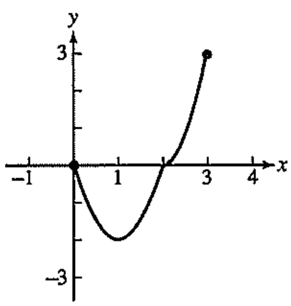
26. $s(t) = 16t^2 + 20t + 5$

27. $L(x) = 2x + \frac{\pi}{2} - 1$

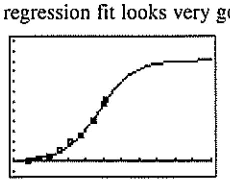
28. $L(x) = \sqrt{2}x - \frac{\pi\sqrt{2}}{4} + \sqrt{2}$
29. $L(x) = -x + 1$
30. $L(x) = 2x + 1$
31. Global minimum value of $\frac{1}{2}$ at $x = 2$
32. (a) T (b) P
33. (a) $(0, 2]$ (b) $[-3, 0)$
(c) Local maxima at $(-3, 1)$ and $(2, 3)$
34. The 24th day
35.



36. (a) Absolute minimum is -2 at $x = 1$; absolute maximum is 3 at $x = 3$
(b) None
(c)

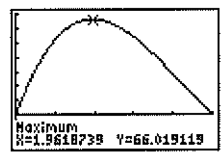


37. (a) $f(x)$ is continuous on $[0.5, 3]$ and differentiable on $(0.5, 3)$.
(b) $c \approx 1.579$
(c) $y \approx 1.457x - 1.075$
(d) $y \approx 1.457x - 1.579$
38. (a) $v(t) = -3t^2 - 6t + 4$
(b) $a(t) = -6t - 6$
(c) The particle starts at position 3 moving in the positive direction, but decelerating. At approximately $t = 0.528$, it reaches position 4.128 and changes direction, beginning to move in the negative direction. After that, it continues to accelerate while moving in the negative direction.
39. (a) $L(x) = -1$
(b) Using the linearization. $f(0, 1) \approx -1$
(c) Greater than the approximation in (b), since $f'(x)$ is actually positive over the interval $(0, 0.1)$ and the estimate is based on the derivative being 0.
40. (a) $dy = (2x - x^2)e^{-1}dx$ (b) $dy \approx 0.00368$
41. (a) With some rounding, $y = \frac{502191.397}{1 + 8.215\,e^{-0.021x}}$
(b) The regression fit looks very good:



[1750, 2300] by [-50000, 600000]

(c) 393,709,000 million
(d) About 1987; a point of inflection.
(e) The U.S. population levels off and never exceeds about 502,200,000 million.
(f) No
42. $x \approx 0.828361$
43. 1200 m/sec
44. 1162.5 m
45. $r = 25$ ft and $s = 50$ ft
46. 54 square units
47. Base is 6 ft by 6 ft, height = 3 ft
48. Base is 4 ft by 4 ft; height = 2 ft.
49. Height = 2, radius = $\sqrt{2}$
50. $r = h = 4$ ft
51. (a) $V(x) = x(15 - 2x)(5 - x)$
(b) $0 < x < 5$



$[0, 5]$ by $[-10, 70]$
(c) Maximum volume ≈ 66.019 in^3 when $x \approx 1.962$ in.
(d) $V'(x) = 6x^2 - 50x + 75$, which is zero at $x = \frac{25 - 5\sqrt{7}}{6} \approx 1.962$.
52. 29.925 square units
53. $x = \frac{48}{\sqrt{7}} \approx 18.142$ mi and $y = \frac{36}{\sqrt{7}} \approx 13.607$ mi
54. $x = 100$ m and $r = \frac{100}{\pi}$ m
55. 276 grade A and 553 grade B tires
56. (a) 0.765 unit
(b) When $t = \frac{7\pi}{8} \approx 2.749$ (plus multiples of π if they keep going)
57. Dimensions: base is 6 in. by 12 in., height = 2 in.; maximum volume = 144 in^3
58. -40 m^2/sec
59. 5 m/sec 60. Increasing 1 cm/min
61. $\frac{dx}{dt} = 4$ units/second 62. (a) $h = \frac{5r}{2}$
(b) $\frac{125}{144\pi} \approx 0.276$ ft/min
63. 5 radians/sec 64. Not enough speed. Duck!
65. $dV \approx \frac{2\pi ah}{3}\,dr$
66. (a) Within 1% (b) Within 3%
67. (a) Within 4% (b) Within 8% (c) Within 12%
68. Height = 14 feet, estimated error = $\pm\frac{2}{45}$ feet
69. $\frac{dy}{dx} = 2 \sin x \cos x - 3$.
Since $\sin x$ and $\cos x$ are both between 1 and -1, $2 \sin x \cos x$ is never greater than 2, and therefore $\frac{dy}{dx} \le 2 - 3 = -1$ for all values of x.
70. (a) The only x-value for which f has a relative maximum is $x = -2$. That is the only place where the derivative of f goes from positive to negative.
(b) The only x-value for which f has a relative minimum is $x = 0$. That is the only place where the derivative of f goes from negative to positive.
(c) The graph of f is concave up on $(-1, 1)$ and on $(2, 3)$. Those are the intervals on which the derivative of f is increasing.